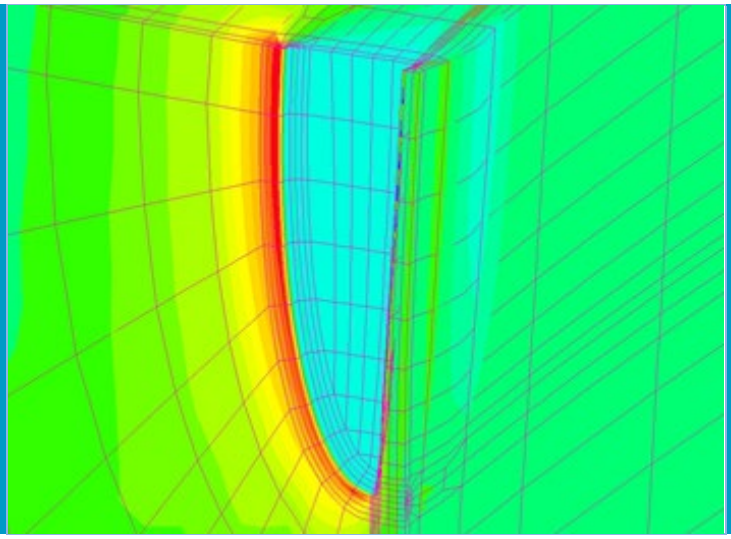
NUCLEAR RESEARCH INSTITUTE

Structural and Lifetime Assessment Department
Integrity and Technical Engineering Division



REACTOR PRESSURE VESSEL INTEGRITY AND LIFETIME EVALUATION

Tensions around the forehead cracks under surfacing in pressure-thermal shock

Value for customers

- Demonstration of reactor pressure vessel (RPV) integrity during original design lifetime and long-term operation (LTO)
- Estimation of RPV residual lifetime
- Optimalization of operational procedures

Applications

- RPV of newbuild nuclear power plants (NPPs)
- RPV of operating NPPs during original design lifetime and for LTO justification

What we offer

- Evaluation of integrity of RPV from point of view of RPV resistance against fast fracture at pressurized-thermal shock (PTS) type events. The evaluation is a multidisciplinary process covering such features as system thermal hydraulic analyses and analyses of mixing in main circulation piping and in reactor downcomer, calculations of thermal and stress fields in the RPV wall using FE method, or fracture mechanics evaluation. The result of RPV integrity evaluation is one of the main parameters entering the evaluation of RPV lifetime. The integrity evaluation is performed for cylindrical part of RPV as well as for the inlet nozzle area.

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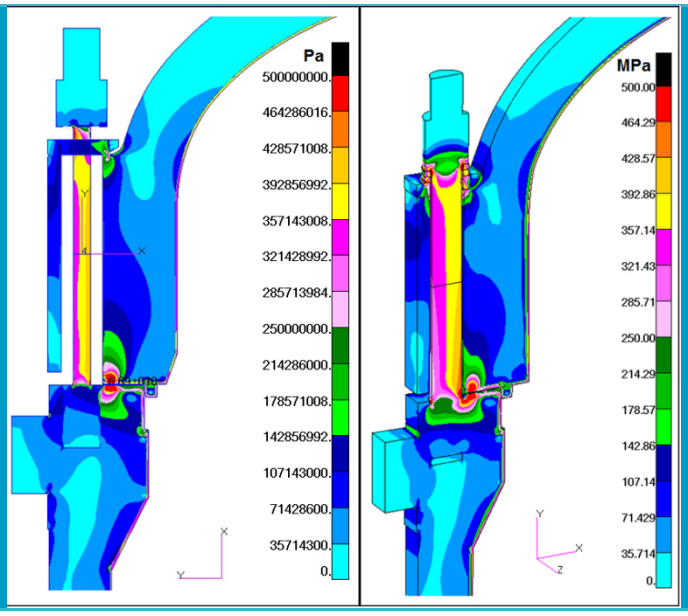
- Long term experience with calculations of the above-mentioned types
- Multidisciplinary approach – tight cooperation between the thermal-hydraulic experts and the structural and fracture mechanics experts, incl. knowledge of material properties
- Interconnection with other parts of RPV lifetime evaluation process (surveillance specimen programme, fluence calculations, non-destructive tests, PSA)
- Experience with using FE codes for thermal and strength calculations (SYSTUS, MARC and ABAQUS FE codes are available)
- Construction of p-T curves and determination of minimum temperature at hydrotests
- Evaluation of RPV failure probability at PTS
- Assessment of static strength and fatigue damage lifetime of the RPV. The assessment is based on thermal and stress fields calculated using three-dimensional FE models for individual nodes of RPV

Our references

- Comprehensive service for RPV and RPV internals lifetime evaluation and management for Dukovany and Temelin NPPs (Czech Republic)
- Evaluation of PTS for Dukovany and Temelin NPPs (Czech Republic), South-Ukrainian, Rivne and Khmelnytskyi NPPs (Ukraine)
- Construction of p-T curves for Dukovany and Temelin NPPs (Czech Republic), South-Ukrainian, Rivne and Khmelnytskyi NPPs (Ukraine)
- Assessment of static strength and fatigue damage lifetime for RPVs of Dukovany and Temelin NPPs (Czech Republic), South-Ukrainian, Rivne and Khmelnytskyi NPPs (Ukraine)
- Participation in development of standards and methodologies such as Czech Regulatory Guidelines, Normative Technical Documentation of Association of Mechanical Engineers, IAEA Guidelines on PTS – coordination of „VERLIFE“, Unified procedure for lifetime assessment of components and piping in WWER NPPs
- Participation in international benchmarks focused on PTS issues (OECD/NEA RPV ICAS, PROSIR, IAEA “VVER PTS Analysis Benchmark” and “CRP 9”, DEFI-PROSAFE, APAL)
- Evaluation of technical condition and lifetime extension for reactor of South-Ukrainian NPP unit 1, Rivne NPP unit 3 and Khmelnytskyi NPP unit 1 (Ukraine)



Calculation of stress in the main flange connection VVER (2D and 3D model)